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SCIENTIFIC RESEARCH BILLS BEFORE THE UNITED STATES SENATE

IN the October 12 issue of SCIENCE, the hearings on the science Bills currently before the Senate were briefly described, but scientists who have not had access to the Senate's Subcommittee Print entitled "Legislative Proposals for the Promotion of Science" and to the Vannevar Bush report entitled "Science, the Endless Frontier," may not have full comprehension of the scope of the proposed legislation or of all the issues involved. For this reason, and in response to specific requests, the American Association for the Advancement of Science presents, with some editorial changes, a memorandum which was prepared for the biologists and agriculturists.

HOWARD A. MEYERHOFF
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEMORANDUM CONCERNING THE SCIENTIFIC RESEARCH BILLS NOW BEFORE THE UNITED STATES SENATE

A discussion of the provisions of the five Bills now before the Senate concerning federal support of science is of immediate interest and value partly because the situation is complicated by the varied provisions of the different Bills, and partly because the whole situation is being carefully studied by the large staff of the Senate Subcommittee on War Mobilization and comprehensive amendments are likely.

It is evident that the Senators interested are anxious to promote the fullest discussion of the measures and would welcome any comments which scientists may care to make. All letters should be sent to both Senator Magnuson and Senator Kilgore at the Senate

Office Building in Washington. The writer should be careful to identify himself by giving his credentials in the way of positions of honor and trust that he holds or has held.

I. *The Legislative Status of Science Bills*

Number	S.1297	S.1285	S.1248	S.825	H.R.3440
Sponsors	Sen. Kilgore, Pepper, Johnson	Sen. Magnuson	Sen. Fulbright	Sen. Byrd	Mr. May
Referred to:	Military Affairs Committee	Commerce Committee	Commerce Committee	Naval Affairs Committee	Naval Affairs Committee and Military Affairs Committee
Present Status:	Referred to Subcommittee on War Mobilization headed by Sen. Kilgore	Referred to Subcommittee headed by Sen. Magnuson	Referred to Subcommittee headed by Sen. Pepper	Reported by Committee July 28, 1945	Passed by H.R. No Senate action as yet

II. *The Purposes of the Bills:*

The *May Bill* (H.R.3440) authorized the National Academy of Sciences to set up a National Defense Board by agreement with the War and Navy Departments. The Bill is solely concerned with military research.

The *Byrd Bill* (S.825) sets up a Research Board for National Security as an independent agency.

The *Fulbright Bill* (S.1248) sets up within the Commerce Department a Bureau of Scientific Research to promote and develop new industrial processes and products.

The *Magnuson Bill* (S.1285) established a National Research Foundation to promote a national policy for scientific research and education, and authorizes support of research relating to national defense and the basic sciences.

The *Kilgore-Pepper-Johnson Bill* (S.1297) establishes a National Science Foundation to support research relative to national defense, medicine and the basic sciences. The Bill provides for the support of such research in non-governmental laboratories, and makes provision for the integration of the over all program of Government financed research.

III. *Joint Hearings on the Bills:*

Three of the above Bills are in essential agreement as to basic aims. Both the Magnuson and Kilgore Bills provide for establishing a Foundation to support research in fundamental and applied sciences, and differ only in the detail of procedures and organization proposed to carry out this aim. The agency proposed by the Fulbright Bill is essentially complimentary to the Foundation.

Senators Kilgore, Magnuson and Fulbright have agreed to hold joint hearings on these several Bills, so that the various aspects of the problem of federal support of research may be fully explored. The hearings opened on October 8, 1945, and will continue until November 2. The hearings will cover all aspects of the problem including the basic sciences, applications in industry, medicine and national defense, the publication and dissemination of information, and scholarships and fellowships for science students.

The hearings have been organized according to subject matter rather than around each of the three bills under consideration. The bills should not be regarded as final insofar as their various detailed provisions are concerned. It is quite likely that they will be altered in the light of the testimony brought forward at the hearings. In fact, a number of revisions of S.1297, based on discussion with various research organizations, are now contemplated; these include:

(1) a provision to protect the Foundation from partisan political pressure;
(2) provision for a Division of Basic Sciences within the Foundation;
(3) provision for the support of long-term research projects;
(4) modification of the patent section to permit the retention of patent rights where a patentable idea produced under a Foundation contract results primarily from privately financed research;
(5) provisions protecting the independence of government laboratories.

Hence, it is anticipated that the hearings will result in the integration of the three legislative proposals in such a manner as to provide the best feasible solution to the problem of federal support of scientific research. This may well result in a joint Kilgore-Magnuson Bill which will include those provisions which are shown by testimony to be most advisable.

The importance of these hearings, both for scientists and the nation, is very clear. Federal support of research holds the promise of new and rapid advances in all fields of science. The problem before us now is

to provide for this support in such a way as to meet the needs both of Science and the National Welfare.

IV. *Basic Issues Involved in the Two Major Bills:*

Because the Kilgore and Magnuson Bills are of major concern to scientists and scientific societies as a whole, there follows a comparison of the two Bills with respect to various major provisions. It should be noted that this comparison refers to the Bills as originally presented and that the Kilgore Bill has already been revised with regard to certain provisions. The final Bill is likely to combine the best features of both S.1285 and S.1297, plus changes prompted by testimony submitted at the hearings.

The Kilgore and Magnuson Bills are in essential agreement concerning the necessity for substantial Federal support of fundamental research in basic sciences and in two fields of Applied Research closely related to the National Welfare: National Defense, and Research in the Medical Sciences. They both recognize the importance of training future leaders in science, and both sponsor a program of federally financed scholarships and fellowships. Likewise they agree on the importance of prompt and full dissemination of scientific findings as a means of promoting the full development of science.

Major Areas of Disagreement

On certain other fundamental issues, however, there are basic differences in philosophy and point of view. The role that a National Foundation will play in American science and in determining the manner in which scientific developments are used in effecting national welfare will depend largely upon the resolution of these issues in the forthcoming legislation. We shall discuss these controversial issues, one at a time, and attempt to indicate the line of reasoning used by those who support the divergent points of view.

1. *Scope and Purpose*

The basic question, assuming that a National Foundation is established, is its relationship to the present structure of the Federal Government and the degree to which the work of a Foundation should be coordinated with other Federally supported research conducted in Government departments and bureaus. The extreme points of view here are:

(a) The creation of a new Government department with a head of Cabinet rank, responsible for the administration of all Government-sponsored research regardless of where conducted.

(b) The creation of an entirely independent agency, charged solely with the administration of Federally financed research in educational institutions and private laboratories, but with no functional relationship to any existent department or bureau.

Obviously neither of the above extreme situations is desirable, nor do either of the two major Bills support either of these extreme positions. The Bills do differ, however, with respect to this basic issue as follows:

The Kilgore Bill provides for support of research in non-governmental institutions (universities); in addition, the Foundation is empowered to make similar contracts with Government laboratories. Finally, the National Foundation is intended to coordinate and integrate all Government-supported research. However, this support should be regarded as supplementing rather than superseding, curtailing or limiting any of the functions or activities of existing Governmental agencies now authorized to engage in scientific research and development. The Kilgore Bill does not authorize the Foundation to exercise any supervisory direction or regulative power over the functions of such agencies or over university or private laboratories. At the same time, however, the Kilgore Bill directs the Foundation to survey continuously all Government-financed research with a view of maintaining a balanced program of research and securing the maximal return on the federal funds used for research purposes.

The Magnuson Bill leans in the other direction. It would direct the Foundation "to promote a National policy for scientific research and scientific education," and "to correlate the Foundation's programs with those undertaken by public and private research groups" but, with the exception of its Division of National Defense, does not provide for any specific tie-in with any existent Government department or agency. Proponents of this Bill argue that science and the public interest will be best served by constituting the Foundation as an independent agency supported by the Government but without functional relationship to any other Government agency.

2. *Control*

Who should control the Activities of the Foundation and be responsible for its program? Again there are two basically different points of view directly related to the divergent philosophy discussed (under 1) above:

(a) Power to be vested in a Director of the Foundation, appointed by the President and solely responsible to him, with provision for an advisory staff composed of government officials, ex-officio, and public members appointed by the President.

(b) Powers vested in a board of public members who serve without compensation, appointed by the President, and responsible to him. Under this system of control, the Board would select a Director of the Foundation to serve as the principal executive officer under the supervision of the Board.

Which of the above types of organization and con-

trol is likely to be in the best public interest? Some argue that a single director can be made much more responsible than a public board and that he is less susceptible to the pressure which various groups would apply in the hope of securing Federal support for special types of projects. This argument furthermore holds that the head of a Government agency such as a Foundation should be responsible directly to the President and not to an intermediate Board of public officials. And since it is a Government agency, the adherents of this position believe that the advisory board should include as ex-officio members Government officials (or their designees) currently responsible for other programs of Government research.

Proponents of alternative (b) above contend that a Science Foundation is a special type of Government agency and as such should be controlled by a Board of public members chosen for their capability but not serving as employees of the Federal Government. This group argues that better administration of scientific research would follow if control is vested in such a board composed of non-Government employees who, they contend, would be more sensitive to the needs of Science.

All those who have given serious thought to the matter of organization and control agree that this problem is of crucial importance, but unfortunately they do not agree on the solution to it. Since the Foundation will be responsible for the distribution of large sums of Government money, it is obvious that pressure groups may seek to divert funds to the type of institution or research in which the groups are most interested. Certainly it is desirable that the Foundation be in the best possible position to withstand such pressure and to plan a program so balanced as to promise the greatest return for the taxpayers' money. One group argues that this will most likely result if administrated by a group of "career scientists who devote their lives to administering research in the public interest." Opponents of this point of view argue that the interests of Science and of the public are not likely to be served by "bureaucrats" but by public representatives who are not Government officials. At this point, the other side suggests that uncompensated members of such a Board would perforce have prior loyalties and, regardless of the composition of the Board, it might not fairly represent all sciences, all types of Institutions, and all sections of the country.

Alternative (a) above is the type of control provided in the Kilgore Bill; alternative (b) is that provided in the Magnuson Bill.

3. *Utilization of Research Findings*

The third and last major issue involved in these science Bills is the question of who should profit economically from such commercially exploitable inventions as may result from Federal-supported research. Again let us note the two possible extreme points of view.

(a) All inventions and discoveries resulting from Government-financed research are to become the property of the United States and to be freely dedicated to the public.

(b) All inventions and discoveries resulting from research sponsored by the Government are to remain the property of the individual inventor, who may in turn dispose of the patent rights in any way he desires.

A current survey of the bureaus and departments now engaged in Government-sponsored research reveals a complete lack of any uniform policy with respect to the assignment of patents. In practically all bureaus, the Government is given a "shop-right"; *i.e.*, the right of royalty-free Government manufacture; but provisions concerning the commercial rights associated with the inventions are extremely variable. In some Government bureaus, it is required that all patents be assigned to the department for free public use, while in other bureaus Government employees retain all commercial rights of patents assigned to them.

Present practice in most commercial organizations requires the assignment of patents to the organization employing the inventor. In most cases the company pays a small flat fee for the patent, but in a few cases, the inventor is allowed a certain royalty. University practice with respect to patents is extremely variable, ranging all the way between the two possible extremes.

Those who lean to alternative (a) above contend that, if public funds are to be spent for research, public interest demands that all the results of the research be made freely available for public use. The proponents of this view point out that most research discoveries do not lend themselves to commercial exploitation and are therefore not patentable. This being the case, they argue that anything other than the free use of all research findings would tend to encourage research talent to concentrate in the areas likely to lead to patentable discoveries with the resultant danger that other equally important areas of scientific endeavor would be neglected.

Those who tend toward alternative (b) argue that permitting the individual scientist to retain patent rights to his inventions constitutes an important motivation for good men to devote their energies to science, and hence that the removal of this reward would result in many able persons or groups refusing to accept Government support for their research.

On the other hand, some scientists argue that permitting the scientist or the research organization to profit from research activities is likely to have certain

untoward effects on the dissemination of scientific data. For example, research work done with the ultimate goal of a patent in mind will tend to be kept apart from the general fund of scientific data, thereby limiting free exchange and dissemination of information.

An intermediate and widely held point of view with respect to the patent issue is that the commercial rights of patents growing out of Government research should accrue, not to the individual inventor, but to the commercial research organization or university by which he is employed. Commercial proponents of this view argue that the salaries paid to scientists employed by their organizations are sufficiently generous to include a financial reward for any probable inventions made by their employees. University spokesmen for this view contend that, in the face of declining financial income from private philanthropy, universities must establish a fund of income-producing patents to support future university research.

Opponents of this intermediary point of view answer the commercial argument as follows: since private industry claims the rights on all inventions growing out of research which it supports, logical consistency demands that the Government claim for the taxpayer the rights to all inventions growing out of research supported by public funds. To the university proponents of this intermediary view, they would reply that, aside from the propriety of using public funds to develop university-owned patents, one of the primary purposes of the Foundation is to provide generous financial support for university research; hence, universities need not worry about accumulating income-producing patents.

The patent issue has many other interesting ramifications. There is, for instance, the ethical question involved in patenting, and thus possibly restricting, the utilization of medical discoveries essential to the promotion of national health. There is also the question of whether a too rigid policy of full and free publication of the results of Government-financed research would result in commercial organizations refusing to accept research and development contracts essential to national defense.

Thus it will be seen that the patent issue is far from clear cut. Many individuals and organizations take strong positions on this issue, but a great many divergent points of view are involved. In general, the larger commercial organizations are strongly behind the position that patent rights for discoveries made by the employee should accrue to their organizations. They are, however, not too happy at the thought that the commercial rights to discoveries made by Government employees may be assigned to their competitors. Small business, on the other hand, because they are unable to support large research organizations, are equally anxious to see all patent rights made freely available on a non-exclusive license basis.

The patent policy of the Kilgore Bill is essentially that of alternative (a) above; *i.e.*, the assignment of all patents resulting from Government-sponsored research to the public. The Magnuson Bill, on the other hand, contains no specific provision regarding patent policy for inventions growing out of Federally sponsored research but leaves the Foundation, like other Government agencies, with the power to negotiate patent arrangements with research contractors as it sees fit.

Minor Issues Involved in the Bills

1. *Use of Existing Research Facilities*

The Kilgore Bill directs the Foundation to use existing facilities of Federal, State, and local government, educational institutions, research foundations and private industrial organizations, and specifies that at least 50 per cent. of the Foundation's funds is to be spent through contracts with nonprofit educational institutions and research institutions. The Magnuson Bill, on the other hand, authorizes the funds to support scientific research, but does not specify the type of facilities to be used, or any limitation on the distribution of funds.

2. *Emphasis on Special Fields of Research*

Both Bills provide for Divisions or Committees on the National Defense and Medical Research. The Kilgore Bill provides that a minimum of 20 per cent. of appropriated funds must be spent in each of these two fields. The Magnuson Bill makes no specific division of distribution of funds for special fields of research.

The Kilgore Bill authorizes the Foundation to permit any research that is in the national interest, including, in addition to National Defense and Medical Research, research in basic science, national resources, methods and processes beneficial to small business, and peacetime uses of wartime facilities. The only additional type of research specifically provided for in the Magnuson Bill is the Division of Physical Sciences "for research in the mathematical and physical sciences." Biological Sciences under this Bill are included under the Division of Medical Research. Administratively, both Bills authorize the Foundation to set up such additional divisions or research committees as may be needed within the provisions of the acts establishing them.

3. *National Science Reserve*

Although both Bills provide for renewable scholarships and fellowships, the Magnuson Bill provides that all recipients of such grants be enrolled in a National

Science Reserve and available for call by the Government for scientific and technical work in time of national emergency. The Kilgore Bill contains no provision for the formal organization of such a reserve.

4. *Appropriations*

Both Bills authorize "such sums as may be necessary," but the Magnuson Bill provides "that the unobligated appropriations are to remain available for four years following the expiration of the fiscal year in which appropriated."

V. *Conclusion*

Revised prints of both S.1285 and S.1297 have narrowed the differences between the two original Bills; but as stated by Senator Kilgore in opening the hearings, full and free discussion of all issues is desirable and necessary to achieve the best legislation. This is the time to introduce changes and to effect improvements. Scientists should make the most of the next two or three weeks to formulate views and to express them.

OBITUARY

HUGH HAMPTON YOUNG

1870–1945

AN appreciation of the life and work of Dr. Hugh Hampton Young can only be expressed here in part, otherwise it would involve the coverage of a prodigious amount of data, for the man manifested no apparent limits to his interests, ambitions and accomplishments.

Dr. Young, the only child of General William Hugh Young and Frances Kemper Young, was born on September 18, 1870, in San Antonio, Texas. There, he attended San Antonio Academy and later Staunton Academy in Virginia. At the University of Virginia, he won a $500 scholarship, and from this institution he received his bachelor's and master's degrees, both in 1893, and doctor of medicine in 1894.

The following year was spent in graduate work at the Johns Hopkins Hospital and Medical School. He became one of the members of a group of distinguished and internationally known physicians who were connected with the development and growth of these two great institutions. Among his famous colleagues were Sir William Osler, Dr. William Henry Welch, Dr. Howard Atwood Kelly and Dr. William Stewart Halsted. Dr. Halsted assigned the task of developing the Department of Genito-urinary Diseases to Dr. Young, who from then on devoted his life to the advancement of this specialty.

He became the friend of presidents, royalty and prominent citizens locally, and in many states and lands. Among his patients were President Wilson, Senator Borah of Idaho, Manuel Luis Quezon (recently deceased President of the Philippine Islands), and a host of others. One of his most renowned friends was "Diamond Jim" Brady, on whom Dr. Young performed an operation on the prostate gland in 1912. As a result, he became a very grateful patient, donating generously to the foundation that bears his name, The James Buchanan Brady Urological Institute.

Dr. Young had a keen interest in civic affairs, and was an active member of many organizations such as the State Mental Hygiene Board, the War Memorial in Baltimore, the Baltimore Museum of Art and the Aviation Commission. As president of the Lyric Theatre from 1919–1945, he practically maintained it for the entertainment and the welfare of the people of the City of Baltimore—one of his most outstanding services to that community.

In 1901, he married Miss Bessy Mason Colston, of Catonsville, Maryland. They had one son and three daughters. At the age of forty-eight years, Mrs. Young died of septicemia (*Streptococcus viridans*). This was a crushing blow to Dr. Young, who had devoted so much effort in an attempt to find a cure for this type of illness through the use of "mercurochrome" and other forms of intravenous chemotherapy.

Upon the entry of the United States into World War I, he sailed to France with General John J. Pershing, who later appointed him Director of the Division of Urology for the American Expeditionary Force. He lowered the rate of venereal diseases far below the pre-war levels. For his accomplishments, he was promoted to the rank of Colonel, and later received the Distinguished Service Medal from Secretary of War Newton D. Baker.

His interests were ever centered around the development of urology. He was a regular attendant at urological meetings in the United States and abroad. He was president of the American Urological Association in 1909. Largely through his efforts, the *Journal of Urology* was founded in 1917. He served well in the capacity of editor-in-chief of this publication to the time of his death, making this journal one of the leading publications of its kind. His scientific achievements included the improvement of the operation of perineal prostatectomy, for which he skilfully devised special instruments, his radical operation for cancer of the prostate gland, the improvement of the cystoscope, the introduction of the Punch instrument, and an instrument for the placing of radium directly upon certain types of bladder neoplasms.

His ability to carry on his arduous research, attend to a large practice and write voluminous works on urological subjects, including "Young's Practice of Urology" (one of the most important and basic books on this specialty) were ever a marvel to his many colleagues. Perhaps as outstanding as any of his many great contributions to urology was his ability to train the men who, at present, are carrying on his ideals and teachings in many of our leading medical institutions.

He not only took an active part in the development of modern urology, but he was ever looking forward, as indicated by his prophetic statement in 1916[1]:

> All surgery has become so perfect in technical detail that advancement in the future will come from researches in the broader fields of chemistry, physiology and experimental medicine and surgery, but these can be very fruitful only when closely associated with the clinical work, and when the clinicians themselves become laboratory men and experimentalists. Such it has been our effort to provide for, with the belief that urology furnishes a most fertile field for research and in the full expectation that it has a most brilliant future ahead of it.

In 1942, Dr. Young became professor emeritus of urology, and in the very clinic that he had built and developed, he died suddenly of a heart attack on August 23, 1945, at the age of seventy-five years.

JOHN A. BENJAMIN
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SCIENTIFIC EVENTS

AWARDS OF THE AMERICAN INSTITUTE OF NUTRITION

THE Borden Award of the American Institute of Nutrition will be given in recognition of research emphasizing the nutritive significance of the components of milk or of dairy products by investigators in the United States and Canada. The award, which may be divided between two or more investigators, will be made primarily for the publication of specific papers, but the judges may recommend that it be given for important contributions over an extended period of time. Employees of the Borden Company are not eligible for this honor.

The formal presentation will be made at the annual meeting of the institute in the spring of 1946. To be considered for the award, nominations must be in the hands of the chairman of the nominating committee, Dr. W. E. Krauss, of the Ohio Agricultural Experiment Station, Wooster, Ohio, by January 15, 1946. The nominations should be accompanied by such data relative to the nominee and his research as will facilitate consideration for the award.

Nominations are solicited for the 1946 award of $1,000 established by Mead Johnson and Company to promote researches dealing with the B-complex vitamins. The recipient will be chosen by a committee of judges of the American Institute of Nutrition and the formal presentation will be made at the annual meeting in the spring of 1946.

The award will be given to the laboratory (nonclinical) or clinical research worker in the United States or Canada who, in the opinion of the judges, had published during the previous calendar year, January 1 to December 31, the most meritorious scientific report dealing with the field of the "B-complex" vitamins. While the award will be made primarily for publication of specific papers, the judges are given considerable latitude in the exercise of their function. If in their judgment circumstances and justice so dictate, it may be recommended that the prize be divided between two or more persons. It may also be recommended that the award be made to a worker for valuable contributions over an extended period but not necessarily representative of a given year. Membership in the American Institute of Nutrition is not a requisite of eligibility for the award.

To be considered by the Committee of Judges, nominations for this award for work published in 1945 must be in the hands of the secretary by January 10, 1946. The nominations should be accompanied by such data relative to the nominee and his research as will facilitate the task of the committee of judges in its consideration of the nomination. Dr. H. E. Carter, of the Noyes Laboratory of Chemistry, University of Illinois, is secretary of the American Institute of Nutrition.

[1] Hugh Hampton Young, *Bull. Johns Hopkins Hospital*, 27: 331, 1916. Quoted by permission of The Johns Hopkins Press.

IN HONOR OF DR. ERNST A. BESSEY

AFTER thirty-five years of active service Dr. E. A. Bessey was recently retired as head of the department of botany of Michigan State College. He has been retained by the college as "distinguished professor of botany."

On September 28 a testimonial banquet was held in the Hotel Olds in Lansing which was attended by more than fifty of Dr. Bessey's former students and colleagues. Professor H. H. Bartlett, head of the department of botany of the University of Michigan, was the principal speaker and paid tribute to Dr. Bessey for his long and illustrious career as teacher, investigator and administrator. A bound volume contain-

ing more than two hundred testimonial letters from Dr. Bessey's former students and friends scattered throughout the world was presented to him. Guests of honor at the banquet were three other members of the department of botany who have been retired from active service recently. They were Dr. R. P. Hibbard, Dr. H. T. Darlington and Dr. Richard de Zeeuw.

Since Dr. Bessey has been relieved of his administrative work he plans to continue his mycological research. A large collection of fungi made in the Hawaiian Islands a few years ago will be the subject of his immediate interest.

HERBERT C. BEESKOW

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NEWS FROM ABROAD

A LETTER has been received by Dr. C. T. Brues, of Harvard University, from Leopoldo B. Uichanco, Agricultural College, Laguna, The Philippines. It reads:

July 7, 1945

Just a note to let you know that I am still alive. I had the good fortune to cheat death at least twice during Japanese occupation of the Philippines; first, in 1943, when I was under sentence of death, and on February 12, 1945, when I somehow managed to elude the Japanese bayonet during the general massacre in the town of Calamba (my home town). I did suffer from dislocated left shoulder because of torture administered by the Japanese in 1943, but I have since recovered almost completely through an operation.

Of the Bussey Institution graduates and former students, Felipe Salvoza is back at his post as assistant professor of dendrology and botany, and also secretary, School of Forestry, University of the Philippines; Vincente Aldaba is again working on textiles in the National Development Company; and Domingo Paguirigan is reorganizing the Bureau of Plant Industry, of which he will probably become the director. They are all well, except that Salvoza's hair has turned gray. I am again dean and professor of entomology in the College of Agriculture of the University of the Philippines.

My own college is in ruins, through the vandalism of the Japanese, who set fire one by one to the different buildings that contained our library, collections, records, laboratory equipment, etc. A few buildings are standing, but empty of their contents. What have not been eaten by fire have been taken away by looters. Now we will have to start over again from where we were about 1910.

The same sad fate befell all other scientific institutions in Manila and elsewhere in the Philippines. The entire Bureau of Science (including the botanical and other collections and the scientific library) was destroyed by Japanese incendiarism. Likewise, the National Library and Museum, the main University of the Philippines plant in Manila, and in fact nearly all the buildings south of the Pasig River, where the country's most valuable historical and scientific treasures were located. Of the Filipino scientists, the following were bayoneted to death by the Japanese while these savages were retreating from the American forces in January, 1945: Mr. Quirico Abadilla, director of mines; Dr. Candido Africa, professor of parasitology, Institute of Hygiene, University of the Philippines; Dr. Miguel Manresa, assistant professor of animal husbandry of my college; and Dr. José B. Juliano, botanist, Bureau of Science.

G. O. Ocfemia, chairman, Library Committee, Agricultural College of the University of the Philippines at Laguna, writes to SCIENCE:

After more than three years out of contact with the rest of the world, the College of Agriculture of the University of the Philippines reopened on July 26, 1945, without equipment and library facilities. The laboratories and the library of the college were reduced to ashes when the Japanese, in their retreat from Los Baños in February, 1945, burned down houses and public buildings and massacred men, women and children, including infants.

We wish to appeal to the generosity of book publishers in the United States for help. We will gratefully appreciate gifts of books to the Library of the College of Agriculture.

Thanking you in anticipation for whatever help you may wish to extend to our library.

Professor Dr. Chr. P. Raven, of the University of Utrecht, has written as follows to Dr. Viktor Hamburger, head of the department of zoology, of Washington University, St. Louis:

I have the pleasure to inform you that the Laboratory of General Zoology of the State University of Utrecht has come through the war quite undamaged.

Alas, the assistant-in-chief, Dr. J. W. de Marees van Swinderen, succumbed in a German concentration camp; one of our co-workers, J. Kloos, was shot by the Gestapo; the other members of the staff survived the terrors of five years of German occupation. Fortunately, we have been able to continue our scientific activity till the autumn of 1944. Then, the lack of fuel and the termination of the supply of gas and electric current made further work impossible; moreover, on account of the continual slave-raids most of us were enforced to remain at home.

After our liberation on the 7th of May we have resumed our work as soon as possible. We are, however, very much handicapped by the fact that we have been cut from our foreign communications and did not receive any scientific papers since 1940. Therefore, may I ask you to send me as soon as possible reprints of your papers of these years? When the dispatch of printed matter from our country is allowed, I will send you my papers and those of my co-workers in return.

Thanking you in anticipation,

Dr. Carl L. Hubbs, of the University of California, sends word to SCIENCE that Dr. L. F. de Beaufort reports that the Zoological Museum of Amsterdam was not damaged by the war. The collections are

intact. The entire staff, scientific as well as technical, survived the miseries of last winter. The preparation of "The Fishes of the Indo-Australian Archipelago," of which Volume VIII appeared in 1940, is being continued.

The following letter has been addressed to Dr. R. A. Cooley, of the Public Health Service, by Dr. B. J. Kryĝsman, of Utrecht:

I am extremely sorry I can't supply you with specimens of ticks from the East-Indies. When I left Java in 1935 the material on which I based the publications about ticks stayed at the Veterinary Institute. I don't know how the conditions are there since the Japanese occupation. It might be possible that my colleagues are still able to help. You may try and write your wishes to The Director, Veterinary State Institute, Buitenzorg, Java.

If they are living and the building is not destroyed, I am sure they will give you some help.

Many thanks for the interest you took in the conditions in Holland. Last winter was terrible. No food (a ration of about 800 calories a week!), no light, no water, no coal, no gas, no wood. No man between 15 and 50 years could go outdoors, as the Huns deported every man they saw. Our wives went along the farms in the country in order to get some food, but the Huns tried to steal their bicycles and they had to walk. You can't imagine those medieval conditions we lived in. Thank Heavens, this nightmare is finished now.

The southern and eastern districts of Holland are badly damaged by air-raids and artillery-fire. The western parts, including Utrecht, suffered from inundations. But our most serious losses are caused by the systematic looting. The Huns stole our cars, trains, ships, barges, machinery, scientific equipment, etc. Holland is free but empty, we are put back to sixteenth century conditions.

In my laboratory we had hidden all valuable things, so our equipment is all right. But still it is difficult to get one's mind in order and to start again. It shall take some time before we can do decent work.

In future I hope to start investigations on the physiology of insects. I shall be pleased to send you our publications on that subject which may interest you and should be glad to receive in exchange all papers from your institute dealing with the physiology and ecology of Arthropods. I am anxious to read your paper on the ticks of tropical Asia.

With kind regards to Dr. Parker.

R. L. Starkey, associate microbiologist of the New Jersey Agricultural Experiment Station, sends a note consisting of some remarks included in a letter received from Holland from one of the students of Professor A. J. Kluyver, director of the laboratory of microbiology of the Technical University of Delft.

Professor Kluyver and his family and his laboratory came safely through this war. Professor Kluyver has been in rather bad health. Last winter we all feared that he would not stand the physical and mental strain which was laid upon all the people in western Holland. . . . All members of the laboratory staff too managed to get through this war safely. From the Technical University of Delft two professors were killed by the Germans and ten per cent. of the students didn't return to Delft in consequence of the German occupation. Most of them have been killed or died in concentration camps. . . . Courses in the university have been started again after having been practically closed for more than two years. After a winter without gas and electricity work at the laboratory can start again, but the use of gas and electricity is strongly restricted. . . . Professor Kluyver recovered quickly after the liberation and has regained his interest in microbiology, which he seemed to have lost almost completely last winter.

Dr. H. T. U. Smith, of the U. S. Geological Survey, writes:

Letters recently received from Dr. Ph. H. Kuenen, of the Geologisch Institutt, and Dr. P. Terpstra, of the Kristallographisch Institutt, both of Groningen, Holland, indicate that they have passed through the war unscathed, but have been cut off from the outer world since 1939. Both would welcome copies of publications which have appeared during the past five years.

Dr. William Randolph Taylor, of the University of Michigan, has received word indirectly, through the kindness of the Smithsonian Institution, that

Dr. Erszébet Kol, of Szeged, Hungary, has been heard from. Dr. Kol is a noted student of the soda lakes of Europe, and of the algae of the snow and ice fields of Europe and America. Just before the war she studied for some months at Michigan, and completed a notable publication on the snow and ice algae of Alaska.

The following is quoted from a letter from Dr. Joseph Maisin, professor in the University of Louvain, addressed to Dr. Mildred W. S. Schram, secretary of the International Cancer Research Foundation. It is dated August 30, 1945:

My health is good, we continued our cancer work during the war but on a small scale on account of the food situation.

We investigated mainly on the relation between diet and cancer.

Personally I have had rather an unpleasant time during the war because I have been a hostage and during the last days I escaped being shot only just by chance.

Professor Dustin died during the war; he had been imprisoned as hostage. Professors Firket and Goormachtig are still in good health. Dr. Lerat is still living but very ill. Professor Deelman, of Amsterdam, is in good health. Professor Forsell, of Stockholm, also. Professor Roussy, Leroux, Madame Laborde and Dr. Lacassagne are all in good health. Professor Regaud is dead. . . .

Dr. Carl Skottsberg, director of the Botanical Garden, Gothenburg, Sweden, wrote to Dr. Frank E. Egler on September 26. Rumors of his death are false. He is enjoying very good health, and his botanical research is continuing as usual.

SCIENTIFIC NOTES AND NEWS

THE Perkin Medal of the American Section of the Society of Chemical Industry has been awarded to Dr. Francis C. Frary, director of research of the Aluminum Company of America, in recognition of "outstanding accomplishments in the field of industrial research."

THE Royal College of Physicians has awarded the Moxon Medal to Sir Alexander Fleming, for his discovery and work on penicillin. The Weber-Parkes Prize and Medal were awarded *in absentia* to Dr. Eugene L. Opie, emeritus professor of pathology of the Cornell University Medical College, for his work on the pathogenesis of pulmonary tuberculosis.

AT the sixty-seventh Founders' Day program of Lehigh University, the honorary degrees conferred included the doctorate of science on Dr. Harvey Bassler, research associate of the American Museum of Natural History.

DR. DETLEV W. BRONK, director of the Johnson Foundation for Medical Physics of the University of Pennsylvania, has been appointed foreign secretary of the National Academy of Sciences and chairman of the Division of Foreign Relations of the National Research Council, *ad interim,* for the period ending June 30, 1946, to take the place of the late Dr. Walter B. Cannon. Election of a foreign secretary will take place at the spring meeting of the academy.

DR. OSCAR F. HEDENBURG, of the Mellon Institute, Pittsburgh, has been elected chairman of the Western Pennsylvania Chapter of the American Institute of Chemists. Other officers are Wm. B. Brown, Pittsburgh Coke and Chemical Co., *Vice-chairman;* Anna M. Coleman, Mellon Institute, *Secretary-Treasurer;* and Wm. H. Hill, Mellon Institute, *National Council Representative.*

THE Virginia Chapter of Sigma Xi, on October 9, held its autumn meeting for the initiation of two associates and fifteen members. On this occasion Dr. Frank W. Finger spoke on "Psychology—the War and After." At a meeting on October 15 officers of the chapter elected were Robert E. Lutz, *President;* Frederick L. Brown, *Retiring President;* Gustav A. Hedlund, *Vice-president;* Joseph K. Roberts, *Secretary;* Lawrence R. Quarles, *Treasurer;* and Cecile B. Finley, *member of the executive committee.*

DR. WENDELL F. HESS, professor of metallurgical engineering and head of the welding laboratory of the Rensselaer Polytechnic Institute, Troy, N. Y., has been elected president of the American Welding Society for 1945–46.

DR. CHARLES DONALD SHANE, professor of astronomy at the University of California at Berkeley, has been appointed head of Lick Observatory on Mount Hamilton. He succeeds Dr. Joseph H. Moore, who has retired, but who remains as astronomer. Dr. Shane became a member of the department of astronomy and in 1935 became a full professor. In 1941–42 he served as chairman of the department. His research has been mainly on spectroscopy. Recently he has been on leave, first as assistant director in charge of administrative matters in the Radiation Laboratory, and later as assistant director in charge of personnel of the Los Alamos project of the university.

PROFESSOR PAUL H. BUCK, anthropologist, since 1942 dean of the faculty of arts and sciences of Harvard University, has been appointed to the newly established post of provost of the university. He also will serve as *ex-officio* dean of the faculty of arts and sciences.

DR. ERNEST LYMAN STEBBINS, New York City Commissioner of Health, has been appointed professor of public health administration in the School of Hygiene and Public Health of the Johns Hopkins University, and assistant director of the school.

DR. J. C. WARNER, head of the department of chemistry of the Carnegie Institute of Technology, has been appointed dean of graduate studies in the College of Engineering and Science.

DR. KENNETH V. THIMANN, associate professor of plant physiology at Harvard University, has returned to the university after three years' leave of absence for research with the Navy.

LIEUTENANT COMMANDER OMAR C. HELD, formerly associate professor of psychology at the University of Pittsburgh, has been appointed dean of the College of Letters and Science at St. Lawrence University, Canton, N. Y.

DR. E. M. SCHOENBORN, JR., has resigned as associate professor of chemical engineering at the University of Delaware, to become head of the department of chemical engineering at North Carolina State College at Raleigh, N. C.

DR. MINNIE A. GRAHAM recently retired from the faculty of Queens College, Charlotte, N. C., where she has been professor of the physical sciences for the past fifteen years. Her successor is Dr. Mildred Morse McEwen, who has had leave of absence for three years to complete her work for the doctorate at

the University of North Carolina. John H. Norman, who has been substituting for Mrs. McEwen, will continue as assistant professor in the department.

PROFESSOR FREDERICK M. GAIGE, director of the Museum of Zoology and curator of insects of the University of Michigan, and Helen T. Gaige, curator of amphibians, have retired, both having been members of the staff for more than thirty years.

THE retirement is announced of Professor Llewellyn Rodwell Jones, for twenty years professor of geography at the London School of Economics and Political Science of the University of London.

CHARLOTTE E. MOORE (Mrs. B. W. Sitterly), research associate at the Observatory of Princeton University, has been appointed physicist in the Section of Spectroscopy of the National Bureau of Standards. She will take up her work in Washington on November 1.

DR. DEAN A. CLARK, assistant director of the public health methods division and senior surgeon of the U. S. Public Health Service, has been granted a leave of absence to become medical director of the Health Insurance Plan of Greater New York.

DR. WILLIAM A. GOSLINE, for two years engaged in the food supply program of the Brazilian Government, Museu Nacional, Rio de Janeiro, has been appointed assistant curator of fishes in the Museum of Zoology of the University of Michigan.

COLONEL HOWARD A. RUSK, Medical Corps, Army of the United States, has been appointed consultant on physical rehabilitation for the Baruch Committee on Physical Medicine. He will make his headquarters at the New York office of the committee.

DR. JOHN L. RICH, professor of economic geology and head of the department of geology and geography of the University of Cincinnati, has returned from a recent government mission to China, where he spent more than eleven weeks as technical consultant in an advisory capacity for both the United States and Chinese Governments.

DR. J. ALBERT RAYNOLDS, formerly technical director of vitamin oil operations for the Atlantic Coast Fisheries Company, has assumed full-time work as technical consultant for the National Oil Products Company, Harrison, N. J.

DR. A. L. HOWLAND, chairman of the department of geology of Northwestern University, and Dr. R. M. Garrels have resumed teaching after a year's leave of absence. They were members of the Section of Military Geology of the United States Geological Survey and were engaged in the preparation of terrain studies for the army engineers. These studies were concerned with such problems as airfield and road construction, water supply, effect of terrain on the use of tanks, prediction of the ease of fortification and tunnel construction, estimates of beaches for landings and problems of stream and river crossings. Dr. J. T. Stark, formerly chairman of the department, is still absent on detached service in southeast Asia, but his return during the academic year is expected. Dr. J. R. Ball was recently promoted to a full professorship.

DR. LAWRENCE ROSNER, formerly chief chemist for the Laboratory of Vitamin Technology in Chicago, has been placed in charge of the chemical, physical and microbiological assay sections of the Nopco Vitamin Laboratories, Harrison, N. J.

DR. LUDWIK ANIGSTEIN, associate professor of preventive medicine of the Medical Branch at Galveston of the University of Texas, attended the first Inter-American Conference on Typhus Fever, held in Mexico City on October 8 and 9. He was invited to discuss the classification of rickettsia.

DR. R. P. LINSTEAD, F.R.S., has been appointed director of the Chemical Research Laboratory in the British Department of Scientific and Industrial Research. He took up this work on October 1.

SIR ALFRED EGERTON, secretary of the Royal Society of London, left on October 2 for a visit to Prague to convey the greetings of the Royal Society on behalf of the men of science of Great Britain to their colleagues in Czechoslovakia. He is the guest of the rector of the Charles University in Prague and will discuss with him and his colleagues what aid British science can give to the rehabilitation of science and scientific education in their country. It is hoped that this visit may do much to enable the people of Czechoslovakia to re-establish firm scientific contacts with men of science throughout the world. Sir Alfred took with him, for the Masaryk University at Brno and the Royal Bohemian Society of Sciences at Prague, scientific publications of the Royal Society issued during the war years.

THE National Research Council announces that it has renewed its subscription to a research table at the Zoological Station at Naples for the year 1946. Inquiries should be addressed to the National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

DR. K. LINDERSTROM LANG, director of the Carlsberg Laboratorium in Copenhagen, Denmark, delivered on October 9 the opening lecture before the Sigma Xi Chapter of Duke University. He reported the results of his recent studies on volume contraction in protein solutions during enzymatic hydrolysis.

A SYMPOSIUM on atomic energy was conducted

on October 4 by the Chapter of Sigma Xi of the University of Cincinnati at which the following papers were given: "Radioactive Materials, the Geologic Source of Supply," Professor O. C. Von Schlichten, associate professor of geology; "Basic Principles of Atomic Energy," Dr. D. A. Wells, professor of physics; and "Radioactive Isotopes in Medical Research," Dr. G. M. Guest, associate professor of pediatrics.

THE annual meeting of the Society of Rheology will be held on October 26 and 27 at the Hotel Pennsylvania, New York City.

THE president and fellows of Harvard College have voted to establish a committee to develop a program in nuclear physics at the university. The corporation has further voted to allocate the sum of $400,000 to the committee to spend within a period of five years in developing the program.

THE School of Mathematics of the Institute for Advanced Study will allocate a small number of stipends to gifted young mathematicians and mathematical physicists to enable them to study and to do research work at Princeton during the academic year 1946–1947. Candidates must have given evidence of ability in research comparable at least with that expected for the degree of doctor of philosophy. Blanks for application may be obtained from the School of Mathematics, Institute for Advanced Study, Princeton, N. J., and are returnable by February 1, 1946.

THE *Journal* of the American Medical Association reports that the Governor of Wisconsin has signed a bill appropriating $25,000 annually "for study of and research into the causes, prevention and cure of cancer and for the purchase of necessary apparatus and supplies for the purpose of carrying on such study and research."

SPECIAL ARTICLES

THE ACTION OF HORSERADISH-PEROXIDASE ON ANGIOTONIN, PEPSITENSIN AND EPINEPHRINE[1]

FROM results obtained with a representative series of phenols, Elliott[2] concluded that all phenolic substances are oxidized with horseradish-peroxidase in the presence of hydrogen peroxide. Szent-Györgyi[3] showed that epinephrine was affected in a similar manner by this enzyme system. Bach and Chodat[4] found that peroxidase in a weak acetic acid medium catalyzed the oxidation of potassium iodide by hydrogen peroxide, releasing iodine. We wish to present data showing that the pressor peptides, angiotonin (hypertensin) and pepsitensin, as well as epinephrine, are oxidized by the action of hydrogen peroxide with horseradish-peroxidase and that this reaction is enhanced by the addition of a very small amount of potassium iodide.

The loss of the pressor response in a pithed cat was utilized as an index of the oxidative degradation of angiotonin, pepsitensin and epinephrine. In addition to this biological assay, the red color produced by the oxidation of epinephrine was measured photometrically.

The horseradish-peroxidase was prepared by the method of Elliott.[2] Angiotonin and pepsitensin solutions were standardized so that 0.5 cc produced a rise in arterial pressure of 50 to 70 mm Hg in a pithed cat. For the bio-assay 1:250,000 epinephrine acidified with acetic acid was employed, and for the colorimetric test, 1:10,000.

Each reaction mixture for bio-assay contained 5 cc of each pressor substance and, in different combinations, 1 cc of hydrogen peroxide solution (0.25 mg per cc), 1 cc of 0.001 N iodine in potassium iodide (KI_3), and 1 cc of peroxidase solution containing varying amounts of the dry horseradish preparation (0.5 to 2.0 mg). The final volume was adjusted to 10 cc with distilled water. The mixtures were incubated at room temperature (25° C) and the reaction was stopped at the desired time by immersion of an aliquot in boiling water for 10 minutes. Then a 1 cc sample was injected into the femoral vein of a pithed cat and the pressor response compared to that of the unmodified angiotonin, pepsitensin or epinephrine solution.

As a substrate for the colorimetric determination, 5 cc of the epinephrine solution was used; to this were added, in various combinations, 1 cc volumes of enzyme preparation (0.1 mg), hydrogen peroxide solution (0.25 mg per cc), and 0.0001 N iodine or potassium iodide. The change in color was measured in a Coleman spectrophotometer at a wave-length of 540 millimicrons.

RESULTS

Fig. 1 indicates the amount of angiotonin destroyed by hydrogen peroxide with peroxidase. In the presence of the same amount of hydrogen peroxide, increasing the quantity of peroxidase caused a greater destruction of angiotonin (compare Curve 2 and Curve 3). The marked, enhancing action of KI_3 is clearly evident (*cf.* Curve 1). The combination of

[1] We wish to express our appreciation to Mr. Robert Sanders for his technical assistance.

[2] K. A. C. Elliott, *Biochem. Jour.*, 26: 1281, 1932.

[3] A. Szent-Györgyi, *Biochem. Jour.*, 22: 1387, 1928.

[4] A. Bach and R. Chodat, *Ber.*, 37: 1342, 1904.

hydrogen peroxide and KI_3 had only a little destructive action on angiotonin (Curve 4); KI_3 alone or with peroxidase in the absence of hydrogen peroxide was inactive.[5] Although not shown in the figure (Fig. 1), oxidative destruction of pepsitensin paralleled

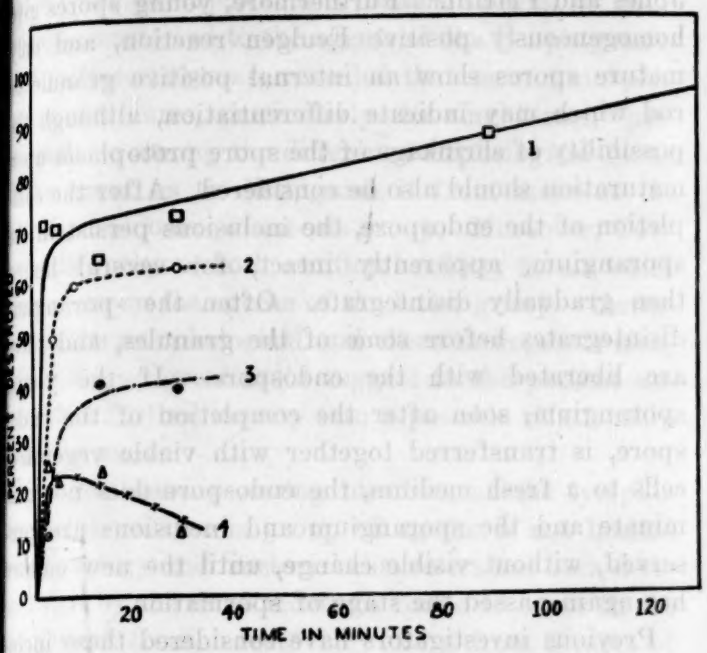

FIG. 1. Oxidative destruction of angiotonin by hydrogen peroxide + peroxidase. Curve 1. Angiotonin + hydrogen peroxide + KI_3 + 0.5 mg peroxidase preparation. Curve 2. Angiotonin + hydrogen peroxide + 1 mg peroxidase preparation. Curve 3. Angiotonin + hydrogen peroxide + 0.5 mg peroxidase preparation. Curve 4. Angiotonin + hydrogen peroxide + KI_3.

that of angiotonin very closely. Epinephrine was also readily oxidized by hydrogen peroxide with peroxidase.

The results of the colorimetric determination of the oxidation of epinephrine (Fig. 2) paralleled the destruction of angiotonin (Fig. 1) in a striking manner. In the colorimetric tests the iodine solution, compared with the potassium iodide solution of equal normality, had very little effect on the reaction. Without the addition of peroxidase neither iodine nor iodide in these concentrations had an appreciable effect even in the presence of hydrogen peroxide (Curves 4 and 5). The increased destruction of angiotonin and epinephrine with potassium iodide is probably due to the liberation of nascent iodine by the action of hydrogen peroxide with peroxidase.

DISCUSSION

The ability of peroxidase-peroxide systems to oxidize phenolic substances *in vitro* is well established, but their action *in vivo* is still open to question.[7, 8]

[5] Cruz Coke[6] showed that iodine inactivated angiotonin (hypertensin), but in the present experiments the small amounts of iodine used had relatively little effect.

[6] Eduardo Cruz Coke, N. Y. Acad. Sci., Section of Biology. Conference on Experimental Hypertension. Feb. 9 and 10, 1945.

[7] K. A. C. Elliott, *Biochem. Jour.*, 26: 10, 1932.

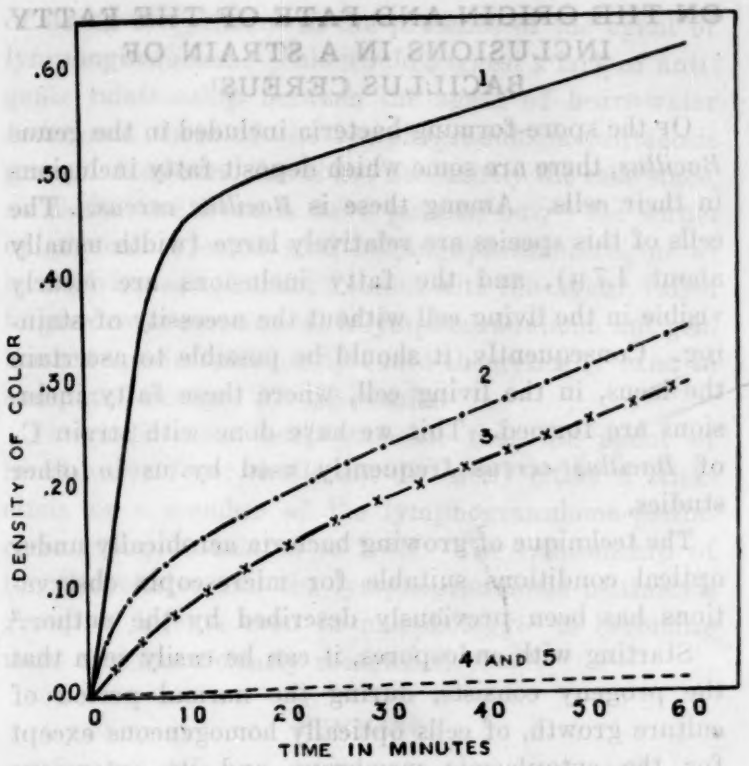

FIG. 2. Red color produced by oxidation of epinephrine. Curve 1. Epinephrine + hydrogen peroxide + potassium iodide + 0.1 mg peroxidase preparation. Curve 2. Epinephrine + hydrogen peroxide + iodine + 0.1 mg peroxidase preparation. Curve 3. Epinephrine + hydrogen peroxide + 0.1 mg peroxidase preparation. Curve 4. Epinephrine + hydrogen peroxide + potassium iodide. Curve 5. Epinephrine + hydrogen peroxide + iodine.

According to Bancroft and Elliott[9] "the enzyme shows its full activity in neutral solution and at concentrations of hydrogen peroxide which are possible within the organism." Dihydroxyphenyl-alanine[2] and tyramine[2] as well as angiotonin and epinephrine are oxidized by horseradish-peroxidase *in vitro*. These substances have all been considered as possible pressor agents in the "humoral" theory of hypertension. The marked effect of low concentrations of iodides in augmenting the action of horseradish-peroxidase suggests that such a combination may influence oxidative destruction of pressor substances *in vivo*. Studies are now in progress to determine the action of such a peroxidase system in hypertensive animals.

SUMMARY

(1) The pressor action of angiotonin, pepsitensin and epinephrine is rapidly destroyed by the horseradish-peroxidase-hydrogen peroxide system.

(2) This reaction is considerably enhanced by the addition of small amounts of potassium iodide.

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[8] J. B. Sumner and G. F. Somers, "Chemistry and Methods of Enzymes," p. 179. New York: N. Y. Academic Press. 1943.

[9] G. Bancroft and K. A. C. Elliott, *Biochem. Jour.*, 28: 1911, 1934.

ON THE ORIGIN AND FATE OF THE FATTY INCLUSIONS IN A STRAIN OF BACILLUS CEREUS[1]

OF the spore-forming bacteria included in the genus *Bacillus,* there are some which deposit fatty inclusions in their cells. Among these is *Bacillus cereus.* The cells of this species are relatively large (width usually about 1.7 μ), and the fatty inclusions are clearly visible in the living cell without the necessity of staining. Consequently, it should be possible to ascertain the locus, in the living cell, where these fatty inclusions are formed. This we have done with strain C_3 of *Bacillus cereus* frequently used by us in other studies.

The technique of growing bacteria aerobically under optical conditions suitable for microscopic observations has been previously described by the author.[2]

Starting with endospores, it can be easily seen that the progeny consists, during the normal period of culture growth, of cells optically homogeneous except for the cytoplasmic membrane and its extensions which divide the inner protoplasm into compartments; these ultimately become independent cells. It can be easily seen that the inner outline of the cytoplasmic membrane is not a smooth curve but is finely jagged.

Toward the end of the growth phase, the inner surface of the cytoplasmic membrane begins to show protuberances which, under aerobic conditions, soon break off and move into the cytoplasm. Under anaerobic conditions, however, the protuberances remain attached to the cytoplasmic membrane.

At the time of spore formation, each cell usually contains several granules (mostly 3 to 5). Those granules stain deeply with Sudan black B, give the Sharp test for protein, and a positive Feulgen reaction. Those reactions are also given by the cytoplasmic membrane from which they originate, and indicate similarity, if not identity, of chemical composition of the two structures. In view of the fact that we observed no other type of intracellular granules in the organism studied, it seems probable that these inclusions are, at least in some cases, identical with the "nuclei" described by various investigators in the *B. megatherium – B. cereus* group. Recently it was also reported by Imšenecki[3] that the fatty granules observed in the aerobic sporeformers may, under certain conditions, stain with basic dyes and have been mistakenly considered nuclei.

The function of these fatty granules is not yet clear to us. Under the conditions of this investigation, they are used up neither by the growing or starving vegetative cell nor during the formation of the spore. Indeed, we have been able to induce spore formation in cells free of any inclusions and, when inclusions were present, we found no evidence that any one is enclosed in the endospore. In this organism, the endospore is formed by a process identical to that described for *Bacillus megatherium* by Bayne-Jones and Petrilli.[4] Furthermore, young spores give homogeneously positive Feulgen reaction, and only mature spores show an internal positive granule or rod which may indicate differentiation, although the possibility of shrinkage of the spore protoplasm upon maturation should also be considered. After the completion of the endospore, the inclusions persist in the sporangium, apparently intact, for several hours, then gradually disintegrate. Often the sporangium disintegrates before some of the granules, and these are liberated with the endospore. If the young sporangium, soon after the completion of the endospore, is transferred together with viable vegetative cells to a fresh medium, the endospore does not germinate and the sporangium and inclusions are preserved, without visible change, until the new culture has again passed the stage of sporulation.

Previous investigators have considered these inclusions to be reserve material. The present investigation seems to indicate that they are the result of a break-up in the cytoplasmic membrane and its extensions, and may represent an abortive tendency of the cell to divide.

The details and records of this work will be published elsewhere.

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[1] Accepted for publication, July 10, 1945.
[2] G. Knaysi, *Jour. Bact.,* 40: 247, 1940.
[3] A. Imšenecki, *Jour. Bact.,* 49: 1, 1945.
[4] S. Bayne-Jones and A. Petrilli, *Jour. Bact.,* 25: 261, 1933.

THE RELATIONSHIP OF THE AGENT OF HEART-WATER FEVER—RICKETTSIA RUMINANTIUM

ALTHOUGH the agent of heart-water fever has been classified with the Rickettsiae, under the name *Rickettsia ruminantium,*[1] there is reason to question the validity of this classification. It is true that the agent is transmitted normally by ticks, but morphologically it is entirely dissimilar from other Rickettsiae and, moreover, it has proven susceptible to sulfonamide chemotherapy.[2] This latter characteristic would serve to associate it with certain agents of the lymphogranuloma-psittacosis group of agents[3] and morphologically also there are points of resemblance. Thus,[1, 4] in the endothelial cells of the blood vessels appear vesicles filled with characteristic

[1] E. V. Cowdry, Part I, 11th and 12th Repts., Dir. Vet. Educ. and Res., Union of S. Africa, p. 161, 1927.
[2] W. O. Neitz, *Jour. South African Vet. Med.,* 11: 15, 1940.
[3] G. Rake, H. Jones and C. Nigg, *Proc. Soc. Exp. Biol. and Med.,* 49: 449, 1942.
[4] E. V. Cowdry, Part I, 11th and 12th Repts., Dir. Vet. Educ. and Res., Union of S. Africa, p. 181, 1927.

elementary bodies and some larger coccoid forms, which have the morphology and the tinctorial characters of agents of the lymphogranuloma-psittacosis group.

It is true that a careful study of the agent of heart-water fever as observable in intima smears, by individuals accustomed to the agents of the lymphogranuloma-psittacosis group, revealed that certain morphological structures, particularly the ring forms,[5] predominate so among the different morphological forms of the agent as to distinguish it from those of the lymphogranuloma-psittacosis group. Moreover, Cowdry[4] and Jackson[5] both mention bacillary forms which never occur in the agents of the latter group. Nevertheless, the morphological and chemotherapeutic similarities are so great as to suggest to the present authors that further inquiry into a possible relationship should be made.

That relationship among members of the lymphogranuloma-psittacosis group of agents is not limited to morphology and tinctorial characters has been demonstrated by the cross reactions found to occur in the complement fixation test.[6,7,8,9] Sera from 5 cases of heart-water fever in sheep were collected by one of us (R. A.) and tested for complement-fixing activity with an antigen prepared from the agent of lymphogranuloma venereum growing in the yolk sacs of embryonated chicken eggs.

On the occasion of first testing the heart-water fever sera, these were all found to be anticomplementary. A serum from a known case of lymphogranuloma venereum, used as a control in the test, gave fixation at a dilution of 1:160. All other controls were satisfactory. Before retesting, all sera, including that from the known case of lymphogranuloma venereum, were heated at 60° C for an hour on two consecutive days. This procedure rendered all the sera free from anticomplementary action even at a dilution of 1:2 except one which was not anticomplementary at 1:5. When these sera were now tested none of them gave any evidence of fixation of complement even at the highest concentration. The anti-lymphogranuloma serum which had been exposed to the same treatment at 60° C still gave fixation at a dilution of 1:160.

It is clear then that these sera from sheep, that had reacted to heart-water fever 39, 66, 71, 110 and 110 days earlier, respectively, had no antibodies capable of fixing complement in the presence of the agent of lymphogranuloma. This would suggest a lack of antigenic relationship between the agent of heart-water fever and those of the lymphogranuloma-psittacosis group. However, this is not necessarily the case since, as Eddie and Francis have pointed out,[10] the serum of pigeons infected with meningopneumonitis, or at least giving complement fixation with this agent, failed to give cross reaction with lymphogranuloma antigen. Such a species peculiarity could theoretically exist in sheep and account for the results.

It would seem most probable that the agent of heart-water fever, while not distinctly either a Rickettsia or a member of the lymphogranuloma-psittacosis group, is related to both. The relationship of the Rickettsiae and the lymphogranuloma-psittacosis group of agents even in morphology[11] is becoming more and more clearly recognized.

Summary

Sera from sheep which were infected with heart-water fever from 39 to 110 days before the serum was withdrawn failed to fix complement in the presence of lymphogranuloma venereum antigen.

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[5] C. Jackson, 12th Rept., Dir. Vet. Serv. and Anim. Indust., Union of S. Africa, p. 161, 1931.
[6] G. Rake, M. D. Eaton and M. F. Shaffer, *Proc. Soc. Exp. Biol. and Med.*, 48: 528, 1941.
[7] G. Rake, M. F. Shaffer and P. Thygeson, *Proc. Soc. Exp. Biol. and Med.*, 49: 545, 1942.
[8] J. A. Baker, *Jour. Exp. Med.*, 79: 159, 1944.
[9] C. Nigg and M. D. Eaton, *Jour. Exp. Med.*, 79: 497, 1944.

THE COMPARATIVE ANTIFOULING EFFICACY OF DDT

Considerable publicity has resulted from the recent announcement[1] that experimental paints containing DDT (2,2-bis(chlorophenyl)-1,1,1-trichloroethane) showed positive suppression of fouling by Balanus species on panels exposed for from three to six months in Yaquina Bay (Oregon). It is perhaps unfortunate that the average reader automatically associates efficacy against barnacles with a "cure-all" for the fouling of ships' bottoms. This is of course untrue.

The United States Navy, for example, in its Docking Report Manual[2] describes at least eight different phyla and classes of marine flora and fauna known to contribute importantly to the fouling phenomena. Thus:

[10] B. Eddie and T. Francis, Jr., *Proc. Soc. Exp. Biol. and Med.*, 50: 291, 1942.
[11] A. M. Begg, F. Fulton and M. van den Ende, *Jour. Path. and Bact.*, 56: 109, 1944.
[1] Science, 102: 2640, 10, August 3, 1945.
[2] Bureau of Ships, Navy Department, Washington, D. C., "Docking Report Manual," 1942.

Key to the Organisms Important in the Fouling of Ships' Bottoms(2)

I. Organisms with hard, often limy shells:
- A. Coiled or twisted tubular shells ..... Annelids
- B. Cone-shaped shells attached directly to the hull, or shells with a long muscular stalk ..... Barnacles
- C. Flat, spreading, granular discs or patches ..... Bryozoa
- D. Paired shells, such as clams, mussels, oysters, etc. ..... Mollusks

II. Organisms without shells:
- A. Green, brown, or red filaments or leaf-like structures, generally near the water-line ..... Algae
- B. Branching tree-shaped growths, the branches not expanded at the tips ..... Bryozoa
- C. Straight or branching growths, each thread terminating in an expanded tip ..... Hydroids
- D. Round soft spongy masses ..... Tunicates

The presence of one or more of these kinds of fouling organisms on a hull is deleterious because (1) the increased weight and friction reduce speed and/or increase fuel consumption; (2) the tendency to fouling overgrowth by other organisms on the areas of bottom paint "insulated" by the precursor organism is severe; and, (3) even non-shell-forming organisms may be directly or indirectly disruptive of the underlying anti-corrosive paint system.

It is thus imperative that specific sensitivities to certain toxicants, demonstrated by some few types of fouling organisms, not be given too great importance in evaluating over-all antifouling efficacy. Professor Dimick did not himself err in this respect; unfortunately, published reports of his observations on DDT in the popular press and elsewhere were not equally conservative.

We have demonstrated conclusively that DDT is relatively ineffective, if not completely inert, to all forms of fouling organisms prevalent in Florida waters with the exception of Balanus species. We understand that this finding is completely in agreement with that of the Oregon investigators, who report DDT to be negative against algae, mussels, oysters, hydroids, annelids and probably bryozoans.

In Table 1, we summarize illustrative data and observations obtained during an 8-month Florida exposure of a typical antifouling paint in which the usual toxicant was replaced with DDT. We present, in comparison, the same formula containing a commercial cupriferous pigment and a control in which there is no toxic pigment present.

TABLE 1

RESULTS OF VISUAL INSPECTION (c)

Pigment (a)	Immersion period	Barnacles	Mollusks	Annelids	Hydroids	Bryozoa	
						Encrusting	Filamentous
DDT	1 month	10	8	7	6	4	10
DDT	2 months	10	6	6	4	3	9
DDT	4 months	10	4	6	5	3	6
DDT	6 months	10	2	6	9 (b)	3	8
DDT	8 months	General rating = 0					
Cu_2O	1 month	10	10	10	10	10	10
Cu_2O	2 months	10	10	10	10	10	10
Cu_2O	4 months	10	10	10	10	10	10
Cu_2O	6 months	10	10	10	10	10	10
Cu_2O	8 months	10	10	9	10	10	10
Fe_2O_3	1 month	4	7	8	6	4	10
Fe_2O_3	2 months	3	6	7	5	4	9
Fe_2O_3	4 months	3	3	7	7	4	6
Fe_2O_3	6 months	4	3	7			
Fe_2O_3	8 months	General rating = 0			9 (b)	4	9

(a) 50 per cent. pigment, 50 per cent. vehicle solids in antifouling paint formulation.
(b) Hydroids sloughed, perhaps by spreading of other organisms.
(c) Marine Fouling Rating Scale: 10–0.
10 = no fouling. 0 = completely fouled.

The steel panels were brush-coated in the usual manner with two coats of a commercially available anticorrosive paint and one coat of the antifouling paints. They were immersed from October 23, 1944, to June 25, 1945, at Daytona Beach, Florida. Details of racking and exposure techniques employed at this test site have been previously described.[4]

The conclusion is obvious, that DDT has a high order of specificity against barnacles, as reported by Professor Dimick. Against other fouling organisms the DDT is apparently inert. It thus seems unlikely that this toxicant can effectively displace cupriferous and/or mercury pigments in the usual ships' bottom paints.

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[3] R. E. Dimick. Private communication.
[4] G. H. Young and coworkers, *Ind. Eng. Chem.*, 35: 433–436, 1943.

THE EFFECT OF PENICILLIN ON THE LETHAL ACTION OF MENINGOCOCCAL ENDOTOXIN IN EXPERIMENTAL ANIMALS[1]

NUMEROUS reports have appeared in the literature concerning the bacteriostatic and bactericidal action of penicillin, but its influence on the toxic effect of bacteria and their products has been given little study. Neter and Will[2] did not find that penicillin prevented the pathogenic action of tetanus toxin in mice.

This is a preliminary report of a study of the effect of penicillin on the toxins of the pathogenic Neisseria.

Endotoxin was prepared from 6 strains of type I meningococcus and 1 strain of type II meningococcus from 18-hour growths on casein-digest agar[3] and washed twice or thrice by centrifugation of saline suspensions. The microorganisms were resuspended in water, brought to pH 8.0, kept 14 hours in the refrigerator, neutralized and sterilized by heating for 45 minutes at 60° C. in the water bath; sterility was proved by culture. The concentration of endotoxin was adjusted so that 0.3–0.5 cc killed at least four fifths of the mice within 30 hours after intraperitoneal injection. Our experiments, however, were not concluded before 90 hours to insure inclusion of all casualties. Preparations were always used before appreciable deterioration had occurred.

The penicillin (sodium salt) used was the ordinary, therapeutic product of several manufacturers.[4] It was administered to mice by subcutaneous injection in doses of 1,000 units contained in 0.1 cc of water.

In one series of experiments on mice, endotoxin was injected intraperitoneally in sufficient amount to kill most or all of the controls and the test animals were treated by courses of injections of penicillin beginning before and continuing after the endotoxin. In some the endotoxin had been mixed with penicillin before injection. Although several different combinations of treatment were tried the experiments have been grouped into two categories (B and C in Table 1) because the striking difference between them was the failure of penicillin acting on endotoxin *in vitro* to reduce its toxicity to any significant degree. On the other hand, all of the experiments in which the mice received several injections of penicillin showed a considerable reduction in mortality as compared with the controls.

TABLE 1

EFFECT OF PENICILLIN ON THE MORTALITY OF MICE INJECTED WITH MENINGOCOCCAL ENDOTOXIN. SUMMARIZED RESULTS OF EXPERIMENTS WITH EQUIVALENT QUANTITIES OF ENDOTOXIN

	Number of mice	Number died	Per cent. died
A. Endotoxin alone (controls)	179	159	89
B. Penicillin mixed with endotoxin. No other penicillin	74	59	80
C. Penicillin by repeated subcutaneous injection. Endotoxin intraperitoneally ...	373	122	33
D. Penicillin inactivated by Penicillinase. Otherwise like C	44	32	73

Among the 373 mice thus treated, some were injected with endotoxin which had previously been mixed with penicillin and some were injected with untreated endotoxin but as no significant difference was observed they were combined in Group C which had an overall mortality of 33 per cent. as compared with a mortality of 89 per cent. for the controls. Penicillin was usually given about 90 and 45 minutes before endotoxin and again about 2, 5, 9 and 24 hours thereafter.

Such substances as saline and casein-digest repeatedly administered failed to influence the lethal action of endotoxin.

Penicillin which had been inactivated by penicillinase[5] was unable to reduce the mortality below 73 per cent.

The protection afforded by penicillin was even more apparent when graded doses of endotoxin were used. The results of such experiments have not been included in Table 1. An illustrative example is given in Table 2.

TABLE 2

RESULTS OF AN EXPERIMENT WITH GRADED QUANTITIES OF ENDOTOXIN

Endotoxin	Control mice untreated	Mice treated with penicillin
	No. died / No. injected	No. died / No. injected
.75 cc	...	13/16
.5	8/8	8/16
.25	8/8	3/16
.1	5/8	.....

Experiments on rabbits weighing 2–3½ kilos were carried out by injection of endotoxin intravenously and penicillin subcutaneously in doses of 10,000–20,000 units every few hours. Among 16 rabbits thus treated, 14 survived and 2 died at 36 and 45 hours, respectively, whereas all of 10 controls died within 24 hours.

These experiments indicate that penicillin repeat-

[1] From the Department of Medicine and the A. B. Kuppenheimer Foundation of the University of Chicago. Aided by a grant from the John and Mary R. Markle Foundation.

[2] Erwin Neter and Dessie Will, *Jour. Bact.*, 48: 261, 1944.

[3] Alden K. Boor, *Proc. Soc. Exp. Biol. and Med.*, 50: 22-25, 1942.

[4] The penicillin was provided by the Office of Scientific Research and Development from supplies assigned by the Committee on Medical Research for experimental investigations recommended by the Committee on Chemotherapeutic and Other Agents of the National Research Council.

[5] Kindly furnshed by Dr. A. J. Liebmann, of the Schenley Research Institute, Lawrenceburg, Indiana.

edly administered in relatively large doses is able to exert a considerable degree of protection against the toxicity of sterile meningococcal endotoxin as measured by its lethal action in mice and rabbits. No evidence was obtained of detoxifying action *in vitro*.

Whether this therapeutic effect is due to penicillin itself or to some impurity in the commercial preparations available to us is a question not necessarily answered by our experiments with inactivated penicillin inasmuch as penicillinase may have denatured the substance responsible for this effect in addition to the penicillin itself. Further work on this problem is in progress.[6]

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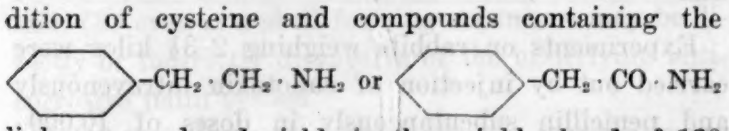
PHYSIOLOGICAL COMPARISON OF TWO STRAINS OF PENICILLIUM

THIS note is to direct attention to an outstanding difference in the capacities of two commercially important strains of Penicillium for biosynthesis of penicillin on different media.

In our laboratory *Penicillium chrysogenum* X1612 consistently produces about 100 Oxford units of penicillin per ml on the following synthetic medium in shaken cultures (100 ml medium/500 ml Erlenmeyer flask making 240 oscillations/minute through a distance of 8 cm). Quantities are in Gm/L: Starch, 5; lactose, 25; glucose, crude, 5; acetic acid, glacial, 6; Na_2HPO_4, 1.6; K_3PO_4, 2; NH_4NO_3, 4; $(NH_4)_2SO_4$, 1; KNO_3, 1; $MgSO_4 \cdot 7H_2O$, 0.25; $FeSO_4 \cdot 7H_2O$, 0.2; $ZnSO_4 \cdot 7H_2O$, 0.04; $CuSO_4 \cdot 5H_2O$, 0.005; Cr (from $K_2Cr_2O_7$), 3 gamma. Additions of numerous adjuvants singly and combined (except phenylacetic or phenaceturic acids or esters of same) produced little, if any, increase in yield.

Under similar conditions *Penicillium* sp., NRRL 1984–A produced less than 20 units of penicillin/ml. Combined additions of indole acetic acid (5 ppm) and of naphthylene acetic acid (0.1 ppm) to this medium approximately doubled the yields. Further additions of cysteine hydrochloride (50 mg/L) and various other adjuvants lacking the phenyl radical increased the yields to about 60 units/ml while addition of cysteine and compounds containing the



linkages produced yields in the neighborhood of 130 to 140 units per ml. This is set forth diagrammatically in Fig. 1.

Addition of sulfite waste liquor (25 ml/L) alone or combined with different adjuvants produced slight additional increases (Fig. 1), the maximum potency attained being about 150 units/ml.

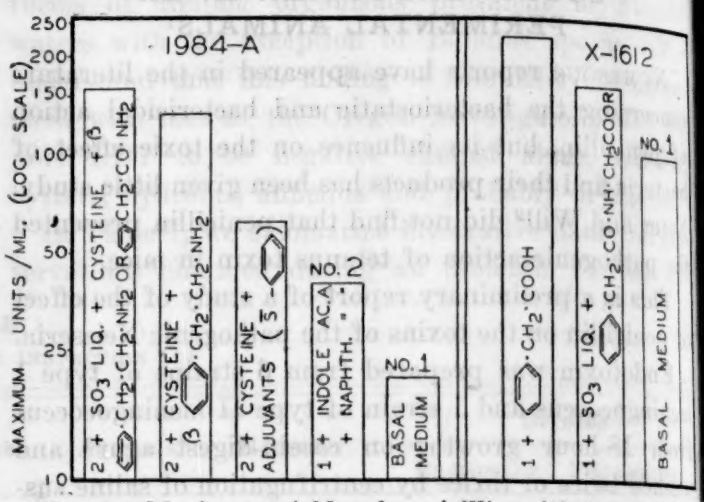


FIG. 1. Maximum yields of penicillin with two strains of penicillium in synthetic media and without various adjuvants.

To summarize, *Penicillium* sp., NRRL 1984-A yields 40 to 50 units penicillin/ml on a purely synthetic medium under the conditions of our experiments if growth factors are present as indole acetic acid and/or naphthylene acetic acid. In such a synthetic medium, adjuvants enhance considerably production of penicillin, as the following are concomitantly made available:

1. Cystein (or cystine in presence of a suitable reducing agent such as sulfite waste liquor)
2. The –C–C–N– chain with the proper linkage at each end
   ‖ |
   O H
3. The phenyl ring, or preferably 2 and 3 combined as phenylaceturates, α-phenylacetamide or β-phenylethylamine.

Penicillium chrysogenum, X1612, on the other hand, appears to be capable of effecting total synthesis of the penicillin molecule in reasonable quantities on a much less complex medium, although again here furnishing a suitable phenyl linkage is beneficial (Fig. 1). Addition of phenylacetic acid, 3.3 Gm/L, to the basal synthetic medium gave maximum yields of 225 u/ml.

In other experiments the influence of addition of sulfite waste liquor and of different adjuvants on the yield of penicillin in a corn steep medium was studied. The standard solution contained corn steep solids, 20 Gm/L; lactose, 30 Gm/L; KH_2PO_4, 0.004 M; $MgSO_4 \cdot 7H_2O$, 0.001 M and $NaNO_3$, 0.035 M. Numerous variations of this solution were studied also in which the total salt concentration (exclusive of those furnished by steep liquor) was uniform but in which the molecular proportions of the three salts were varied. In all, thirty-six combinations of salts and adjuvants were tested with and without sulfite waste with each strain of mold. In every combination that was studied addition of sulfite waste liquor

[6] The authors are grateful for the technical assistance of Mary Bogie and Lois Nelson.

caused a decrease in yield with X1612 approximately as follows:

5 ml sulfite/L depression = 12–20 per cent.
15 ml sulfite/L depression = 20–35 per cent.
30 ml sulfite/L depression = 35–50 per cent.

but in nineteen of the combinations, addition of sulfite waste improved the yields with 1984–A. The range of increases with this strain was from 8 to 73 per cent. The mean increase was 37 per cent.

These experiments emphasized again the inherent differences in the two strains of mold for synthesis of penicillin and point to the necessity of furnishing 1984–A with more complex and partially linked precursors of the penicillin molecule.

The potencies reported in this paper were determined by standard cylinder plate assays using *Staphylococcus aureus*, NRRL 313 (F.D.A. strain 209P) as the test organism and a standard of calcium penicillin G.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE HISTOCHEMICAL LOCALIZATION OF ADENOSINETRIPHOSPHATASE IN PLANT AND ANIMAL TISSUES

ADENOSINETRIPHOSPHATASE (ATPase) has become a focus of interest to research workers in widely diverse fields of biological and medical sciences because of its critical role in intermediary metabolism. The principle of Gomori's technique for the localization of alkaline[1] and acid,[2] glycerophosphatases in animal tissues by histochemical reactions has been adapted to the demonstration of ATPase; the various modifications that the glycerophosphatase procedures have undergone have been summarized in a recent review.[3] The principle of Gomori's technique is the precipitation *in situ* of the phosphate, liberated enzymatically, by calcium in alkaline media, and lead in acid media, and the conversion of the insoluble phosphate to the more easily visualized black lead sulfide.

The pH-optimum for ATPase in animal tissues[4, 5] occurs at about 9.0. Mouse heart and wheat were chosen to represent the two types of tissue, and since Booth[6] showed that other phosphatases in wheat have optimum activity at a pH of 5.1–5.2, this range of hydrogen ion concentration was tried for the ATPase and it was found to be suitable.

One innate difficulty with the method is the fact that the presence of free phosphate at a given histological or cytological location may obscure the phosphatase activity at this site. The difficulty is appreciably reduced when paraffin, rather than frozen, sections are employed, since much of the free phosphate is removed in the preparation of the paraffin sections. Of course, the tissue infiltrated with paraffin has undergone some loss in enzyme activity; however, this may be compensated by employing longer digestion periods.

The limited availability of ATP made it imperative that some modification of the usual procedure, employing a staining dish or Coplin jar full of substrate solution, be introduced. Accordingly a simple hanging-drop technique was devised that requires only one drop of the substrate solution for each tissue section. This technique is generally applicable to all cases where it is desirable to use a minimum of substrate or other reagent in histochemical tests.

The acid and alkaline substrate media are prepared in the following manner:

Substrate solution: Dissolve 5 mg of the Ba salt of ATP in 0.5 cc of 0.1 M HCl, add 0.1 cc of a Na_2SO_4 soln. to precipitate the Ba (1.11 per cent. Na_2SO_4 was required by our sample of ATP[7]), centrifuge and neutralize the supernatant liquid with 0.1 M NaOH.
Acid substrate medium: Combine in the following order: 0.5 cc of 0.1 M acetic acid, 0.25 cc of 0.1 M $Pb(NO_3)_2$, 0.25 cc of neutral substrate soln., 0.10 cc of 0.1 M $CaCl_2$, and 1.5 cc of 0.1 M sodium acetate. Centrifuge before use to remove turbidity.
Alkaline substrate medium: Combine the following: 0.75 cc of neutral substrate soln., 0.5 cc of pH 9.0 buffer (9.36 cc 0.1 M sodium barbital + 0.64 cc 0.1 M HCl), and 0.05 cc of 0.1 M $CaCl_2$. Centrifuge before use.
Control media: Replace the neutral substrate soln. by distilled water.

The enzyme activity is demonstrated as follows: Fix heart tissue in acetone for the preparation of both frozen and paraffin sections. Soften the wheat kernels by soaking in water for 4 to 6 hours before sectioning on the freezing microtome, or for 7 hours before fixing in absolute alcohol for the preparation of paraffin sections. Cover a frozen section (15 μ

[1] G. Gomori, *Proc. Soc. Exp. Biol. and Med.*, 42: 23, 1939.
[2] *Idem., Arch. Path.*, 32: 189, 1941.
[3] D. Glick, *Ann. Rev. Biochem.*, 13: 705, 1944.
[4] K. Bailey, *Biochem. Jour.*, 36: 121, 1942.
[5] K. P. DuBois and V. R. Potter, *Jour. Biol. Chem.*, 150: 185, 1943.
[6] R. G. Booth, *Biochem. Jour.*, 38: 355, 1944.

[1] With the assistance of Ruth Birch, Marjorie Decker, Iola Dunkle and Patricia Streator.
[2] Currently on leave from the University of California College of Pharmacy.
[7] The ATP and mouse hearts were obtained through the courtesy of Professor M. B. Visscher, Dr. H. G. Wood and Dr. M. F. Utter, of the Physiology Department of the University of Minnesota Medical School.

thick) or a deparaffinized section (10 μ thick), which has been fixed to a slide with a collodion film, with a small drop of substrate medium. Place a hanging-drop slide over it so that the drop is enclosed in the chamber formed by the depression. The drop should not touch the chamber walls at any point. Invert the slides, leaving the section covered by the hanging drop. For digestion periods longer than 4 hours it is necessary to seal the edges of the two slides with vaseline to prevent appreciable evaporation. Place in a 37° oven for the time indicated below:

Wheat kernel, frozen sections: embryo, 15–30 min.; aleurone cell region, 5–10 min.
Wheat kernel, paraffin sections: embryo, 2 hrs.; aleurone cell region, 1 hr.
Heart tissue, frozen sections: 2 hrs.
Heart tissue, paraffin sections: 18–24 hrs.

If vaseline was used, remove with benzol, and wash sections with 3 changes of distilled water. (In the case of alkaline ATPase, place in 1 per cent. $Pb(NO_3)_2$ for 15 minutes at this point, to convert the calcium phosphate to lead phosphate, and wash well in distilled water.) Dip into 2 per cent. acetic acid and rinse thoroughly with distilled water. Place in 2 per cent. ammonium sulfide for 2–3 minutes, wash with several changes of distilled water, dehydrate in 95 per cent. alcohol for 2–3 minutes followed by absolute alcohol for 5 minutes, clear in oil of thyme for 3–4 minutes, treat briefly with 3 changes of xylol, and finally mount in balsam.

Essentially the same procedure has been successfully adapted to the demonstration of glycerophosphatase and thiamine pyrophosphatase in sections of wheat kernels and sprouts. These studies, in addition to those on ATPase, as well as similar ones on other phosphatases in wheat, will be reported in detail elsewhere.

SUMMARY

A method has been described for the histochemical localization of acid and alkaline ATPase in plant and animal tissues respectively. A hanging-drop technique has been developed that permits the use of a minimum of substrate, *i.e.*, one small drop for each tissue section. ATPase in wheat was demonstrated for the first time.

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DISCUSSION

THE EFFECT OF MOTION PICTURES ON BODY TEMPERATURE

IN SCIENCE for September 7, 1945, Dr. R. Barrington Brock, of Croydon, England, offered two items of criticism concerning my note on "The Effect of Motion Pictures on Body Temperature."[1]

(1) He wonders why "the figures show a similar rise in body temperature for all types of film," but the figures show nothing of the kind. I definitely stated that the oral temperatures on "movie" days varied from 99 to over 100° F. It was because the rise in temperature seemed related to the degree of excitement produced by the film that I suggested that the collective change in body temperature of a preview audience might be used to predict the box office success of a film. Evidently that conclusion escaped Dr. Brock's attention.

(2) This criticism rests on more solid physiological grounds—whether we are not dealing here with a "rise in body temperature occasioned by close contact with masses of other people in a confined space." That this is not the case is shown by the fall in body temperature of students who sit close together at regular university lectures. If the subject-matter of the lecture is not very interesting, and especially if the room is darkened for showing slides or scientific motion pictures, the degree of muscular relaxation and fall in temperature are often great enough to produce drowsiness and even sleep. Furthermore, in this country motion picture theatres are usually air-conditioned, and in the summer the air in them may feel unpleasantly chilly. We have found that sitting down and relaxing under such conditions produces an even greater lowering of the body temperature than occurs in a warm lecture room. However, a comparison of "movie" temperature figures for summer and winter showed no difference. This suggests that the temperature raising effect of motion pictures was sufficient to overcome the downward tendency resulting from air conditioning.

Thus, the rise in body temperature was related to the degree of excitement produced by the film and was in no way due to close contact with other people in a confined space. Indeed, I venture to predict that a comparable rise in body temperature will be found in persons who, in the privacy of their homes, have been listening for some time to a "hair-raising" melodrama over the radio or have been reading an unusually exciting book. The fact that some books act as soporifics, while others keep one widely awake long beyond the customary going-to-bed hour, is prob-

[1] SCIENCE, May 18, 1945.

ably related to the degree of muscle tension and level of body temperature induced in the reader.

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"THIS IS THE ENEMY"

I HAVE just returned from a four-month tour of duty in Germany where I had opportunity to talk with a fair cross section of Germans and to visit some biological laboratories. In Munich I visited the *Zoologisches Institut* built by Rockefeller for Professor K. von Frisch. It was here von Frisch and his students investigated the problems of sensory physiology: hearing, color vision, smell, taste, "Schreckstoff" in fish; here also was produced a classic work in animal behavior, "Die 'Sprache' der Bienen," an experimental analysis of the methods of communication among bees. This Institut is badly bombed; only the first floor and basement remain intact. Professor v. Frisch's splendid library on sensory physiology and animal behavior was destroyed when his home in Munich was blasted—he had moved all his books and effects from the Institut to his residence because he believed that the residential area would not be bombed. These consequences forced him to remove his research projects and some of his assistants to his summer cottage near Salzburg, which he converted into a laboratory. Here he suffered additional losses of personal property from looting. All this was heaped upon a man who had been oppressed all these years by the Nazis because his grandmother was not "Aryan."

It was my good fortune to spend several weekends with this scientist, who, in my opinion, is one of the "greats" in biology in our day. A quiet manner, gentle humor and clarity of explanation and thought characterize him. He is continuing his research with what vigor one can muster under limited food intake. His spirit has not been crushed by the Nazis.

This case is cited to illustrate an example repeated, with minor variations, among scores of educators and research workers. Here are men and women who can still contribute richly to science. Many have carried on in spite of political oppressions—they are hungry, without shelter and without heat for their broken laboratories and homes. Their libraries have been burned and blasted.

Over the portals of Cornell University is the slogan, "Above all Nations," a fitting epitome of the international code of science. It is my opinion that those readers of SCIENCE who have acquaintances in Germany would do science, and, may I venture, world peace a great service by sending them a word of encouragement or perhaps some reprints or warm clothing.

A colleague's comment on the above note was, "Last week has brought a letter from Dr. ——— of Oslo showing what the Germans did in Norway. That is also true, but no more true than the picture you present."

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SCIENCE IN RUSSIA

N. A. MOROZOV, an honorary member of the Academy of Sciences, U.S.S.R., whose ninetieth birthday was celebrated a few months ago, is the author of over 150 works dealing with astronomy, mathematics, chemistry, geophysics, biology, history, meteorology and aviation. He also writes poetry, and published between 1924 and 1932 seven volumes of a projected ten-volume work on the life of Christ.

The latest issue of *Vestnik Akademii Nauk U.S.S.R.* (Record of the Academy of Sciences U.S.S.R.) received in this country is No. 10 for 1944. It is devoted entirely to the achievements of the president of the Soviet Academy of Sciences, V. L. Komarov, professor of botany at the University of Leningrad, on the occasion of his seventy-fifth birthday and the fiftieth anniversary of his scientific work. A number of articles describe his activities as the leader and organizer of the Soviet scientific activities and the outstanding botanist of U.S.S.R. The flora of the Far East are the main object of his studies. In 1934, after a number of travels through Siberia, Yakutia, the Far East, Trans-Caucasia, Finland, etc., he undertook a systematic survey of all plants growing on the territory of the U.S.S.R. This is entitled "Flora of the U.S.S.R." It is published in twenty volumes, of which eleven volumes have already appeared.

The Academy of Sciences, U.S.S.R., honored on April 25 the memory of A. S. Popov (1859–1905), the Russian inventor of radio. On November 20, 1894, Popov demonstrated his apparatus to the Russian Physico-Chemical Society. However, April 25, 1895 (May 7 according to the new style calendar), is regarded as the date of his invention, because on that day he presented a paper entitled "The Reaction of Metallic Powders to Electromagnetic Vibrations," to the Physico-Chemical Society. In January, 1896, he demonstrated his radio receiver to the Kronstadt Division of the Technical Society. The distance across which the transmission of the signals could be made was increased by Popov in the spring of 1897 to 640 meters from a ship afloat to a station on shore. Subsequently, in 1899, Rybkin achieved radiotelephone transmission across a distance of about 45 km.

Marconi applied for a patent in Italy on June 2, 1896, and in Russia in December, 1897. His application was denied in Russia.

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SCIENTIFIC BOOKS

METEOROLOGY

Meteorology, Theoretical and Applied. By E. WENDELL HEWSON and RICHMOND W. LONGLEY. 468 pp. 194 figs. New York: John Wiley & Sons, Inc. 1944. $4.75.

Weather Around the World. By IVAN RAY TANNEHILL. 200 pp. 55 figs. Princeton: Princeton University Press. 1943. $2.50.

Fogs, Clouds and Aviation. By W. J. HUMPHREYS. 200 pp. 93 figs. Baltimore: The Willams & Wilkins Company. 1943. $3.00.

An Introduction to Weather and Climate. By GLENN T. TREWARTHA. 545 pp. 196 figs. 7 plates. New York: McGraw-Hill Book Company, Inc. 1943.

Methods in Climatology. By VICTOR CONRAD. 228 pp. 46 figs. Cambridge: Harvard University Press. 1944. $4.00.

A BY-PRODUCT of the growth of aviation immediately prior to and during World War II has been a vast expansion of meteorology. Research and instruction have been vigorously prosecuted and great progress in both lines has been made. Now, for the time being, the scope of meteorology has been established and its content crystallized. Meteorology is a science which partakes at one time of physics and of geography. Depending on the point of view and the emphasis, the field of meteorology breaks down into several subdivisions. Dynamic meteorology, dealing with forces and motions in the atmosphere, is exclusively physics. Physical meteorology also is largely physics, but, in so far as it deals with geographical distributions of the physical qualities of the atmosphere, it is geography. Synoptic meteorology refers back to dynamic and physical meteorology for its materials but is largely geographic in method. Various special applications of meteorology have resulted in further subdivision of the field. Thus, for example, we have aeronautical meteorology, marine meteorology, agricultural meteorology, hydrometeorology and medical meteorology. The place of climatology in the hierarchy of meteorological science is vague and ill-defined. The meteorologists with a background in physics regard it as "statistical meteorology" dealing with mean values of the meteorological elements. Those with a geographical background, on the other hand, think of it as being concerned with a synthesis of the atmospheric factors that give character or individuality to geographic regions.

The large number of text-books that have appeared in the last few years fit readily into the established framework: novelty and innovation have become rare. "Meteorology—Theoretical and Applied" follows the established pattern. The first part, called "Theoretical Meteorology," contains material that is usually classed as dynamic meteorology and follows the outline of Haurwitz' excellent book of that name, chapter by chapter. The second part, called "Applied Meteorology," gives the student the material usually associated with synoptic meteorology.

Three chapters scattered through the book are innovations. At the end of Part I there is a chapter on statistical analysis of meteorological data. Toward the end of Part II there is a brief chapter on climatology and the last chapter is entitled "Meteorology Applied to Various Human Activities." The treatment of these new subjects is necessarily superficial; furthermore, they are not properly integrated into the main text. For example, the climatology chapter is introduced because of the "importance of climatology to the meteorologist." Yet the authors accept the prevalent view that "the statistical facts presented by the climatologist are not vital to the forecaster."

As a matter of fact, weather forecasts are unintelligible except when referred to the expected conditions of the time and place, which are the climate. Otherwise how can we get any meaning out of the following forecasts for the District of Columbia? January 5, 1945—Clear and not quite so warm; to-morrow fair and warmer. July 2, 1945—Considerable cloudiness and not so warm; to-morrow fair with moderate temperature. The forecaster has no fixed standard but one that changes with the seasons. In discussing the possibilities of weather forecasting, Joseph Henry, in 1855, stated the objective to be "to trace to their source, various perturbing influences which produce the variations from the mean, and thus arrive, at least, at an approximate explanation of the meteorological phenomena which are constantly presented to us."[1]

During the war many popular books have been written on a great variety of subjects to assist the men in the armed forces to understand unfamiliar things in distant places. "Weather Around the World" and "Fogs, Clouds and Aviation" have this objective. "Weather Around the World" is a Baedeker's Guide to weather and climate for travelers. It is simply written, but at the same time it answers most of the questions about the weather that would probably arise in the mind of the non-meteorologist. Especially interesting are the descriptions of weather to be expected on actual ocean voyages.

[1] Joseph Henry, "Meteorology in its Connection with Agriculture." In Report of the Commissioner of Patents for the year 1855, p. 358, Washington [D. C.] (34th Cong., 1st Sess., H. Ex. Doc. 12.)

This little book should be very useful to travelers long after the war is over.

"Fogs, Clouds and Aviation" is a reprinting in book form of a delightful lecture entitled "Fogs and Clouds" delivered by Dr. Humphreys at the Franklin Institute and printed in the journal of that institution in 1922. Nearly 100 well-chosen photographs of cloud forms are reproduced; almost twice as many as in the original publication. The text, however, is only slightly changed. Brief biographical sketches of John Aitken and Luke Howard have been introduced, and here and there new material has been added; for example, a description of the "helm bar" of the Lake District of northern England. However, extremely little has been inserted to justify the addition of the word "aviation" to the title. We are told that the "cirrus is a valuable one-way screen," that cumuli are "convenient hide-and-seek places for the aviator," and that "the aviator should keep either above or below a layer of billow clouds, since in their midst the air is likely to be quite bumpy." Even so, the book is a valuable one for the aviator, just as it is for any other non-meteorologist, since it describes and explains fogs and clouds.

"An Introduction to Weather and Climate" is already well established as a standard text through the first edition which appeared in 1937. It was written from the geographical point of view by a geographer, whose university course is called climatography. Although the book deals with descriptive and regional aspects of climate, it does not stop with mere description; it goes far in the explanation of regional climates. The first edition contains 373 pages; the new edition 545. The author has utilized material made available by recent advances in meteorology and has rewritten and expanded the original text in the light of classroom experience. A new chapter dealing with the origin and modification of air masses, atmospheric fronts and the air-mass characteristics of some of the continents has been added. The first edition of this book was good; the new edition is better.

"Methods in Climatology" was written, according to the author, for students of geography. He explains that "climatology and climatography appear as parts of geography, because they are essentially necessary to describe the suface of the earth and its changes." He maintains that in the climatological studies of the geographers, "geographical methods are kept in the forefront, and specifically climatological methods are not so much used." He holds that the "too-schematical descriptions" characteristic of climatography can be avoided by adapting various "methods of mathematical statistics and theory of probability" to the analysis of the data. The first part of the book deals with statistical methods. The second part is concerned with the variations of the elements in the course of time at one fixed place. The third part presents the comparison of the elements which are observed synchronously at different places, and arrives at their geographical distribution. The last section of the book gives suggestions for the arrangement of a more or less complete climatography.

The climatological elements listed by the author include, (1) radiation of sun and sky, (2) temperature of the air and of the surface of the earth, (3) wind direction and velocity, (4) humidity and evaporation, (5) cloudiness and sunshine, (6) precipitation, (7) snow cover and (8) air pressures. The elements may be classified as (1) primitive elements, which are directly observed or estimated, such as temperature, precipitation and cloudiness, (2) combined elements, such as continentality and equivalent temperature, and (3) derived elements, such as the duration of the frost period and the growing season.

The author's first concern is with the comparability of the data. He warns that instrumentation and exposure vary from one country to another; for example, rain-gage funnels range in area from 20 square inches to 78 square inches (50 square inches in the United States) and the elevation of the rim of the receiver above the ground varies from 12 inches to 59 inches (34 inches in the United States). He quite properly insists that the climatologist "should be aware of these inequalities and discontinuities."

The author next presents four chapters on statistical methods. Although this material may be found in any text on statistics, it is appropriate here because of the examples from climatology. In parts 2 and 3 we have the real substance of the book: here various statistical procedures are applied to the serial and spatial data of climatology.

"Methods in Climatology"[1] is a useful book. Nevertheless, it is disappointing. Workers in the United States badly need a handbook on methods, yet this book, although written in English and published in this country, is clearly for European students. The author confesses that it is developed from lecture notes and student theses from the University of Vienna. Most of the citations are to his own works published in German. This results in a curious incongruity. He says that "everyone with high-school training should be able to understand" the mathematical procedures which he presents. Yet, repeatedly, "for lack of space" he does not complete the develop-

[1] This book was reviewed in SCIENCE for March 16, 1945, by Dr. R. G. Stone. This review presents a different point of view.

ment of a theme but refers the student to a German reference. Not only does he overestimate the language training of our high-school graduates but their training in mathematics as well.

The author has not taken the trouble to become acquainted with the American literature. He refers to the *Monthly Weather Review* scarcely a half dozen times, yet for many years it was a primary source of material on climatological methodology. By way of contrast, we may cite the work of Geiger,[2] one of his former colleagues, who obtained 60 out of a total of 82 references to frost from the *Monthly Weather Review*. Apparently the author has not examined the few citations to American literature that he has included. For example, he says (p. 95) that he could not find a proper definition of killing frost in the available literature and quotes a definition given to him by a colleague. The quoted definition is a paraphrase of one by W. G. Reed in "Frost and the Growing Season," a part of the Atlas of American Agriculture, to which the reader is referred. Only in one other place, in a footnote in the conclusion of the book, does he cite the Climatic Section of the Atlas of American Agriculture. Here he calls it a "monumental work" and promises the reader "a rich source of different methods of representation," but he cites the work incorrectly and does not mention J. B. Kincer, the author of the principal parts.

No book for use in this country dealing with the application of statistics to climatology should fail to make use of the innumerable articles that have appeared in the *Monthly Weather Review* during the last 30 years.[3] Perhaps Professor Conrad intends to issue a second edition of his book. If so, it is hoped that he will become acquainted with our literature and consider the needs of our students during its preparation.

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THE CHEMICAL FORMULARY

The Chemical Formulary. Vol. VII. By H. BENNETT, editor-in-chief. xxxii + 474 pp. Brooklyn, N. Y.: Chemical Publishing Company, Inc. 1945. $6.00.

THIS is the seventh volume of the series, and as in previous volumes the editor-in-chief has had the assistance of an editorial board of about fifty assistant editors in industrial and educational organizations. A footnote to the preface states that all the formulae in volumes I to VII are different except for a few typical cases used in the introduction to illustrate directions and advice for new users of the volumes.

The fields covered in the present volume include adhesives, beverages, cosmetics, emulsions, foods, inks, lubricants, materials of construction, metals and alloys, paints and varnishes, pyrotechnics and explosives, rubber, plastics, detergents, textiles, etc.

The directory of sources of chemicals and supplies in the present volume now numbers 606 sources. This will prove of value to users of the volume, since many of the substances mentioned in formulae throughout the book are trademarked or copyrighted "trade names" and could not be secured on the open market either by reason of their compound nature or secret composition. The editor feels justified in including such substances, since without them many ideas and processes offered in formulae of specialty producers would have been automatically eliminated.

A large number of the formulae and compositions presented in the present volume are taken from the patent literature. In most cases the original patent number is given so that users of these formulations may refer to the original sources. Those who are familiar with the use or application of such formulae will recognize the generally limited usefulness of such patented disclosures.

Tables of weights and measures, a list of foreign sources of chemicals and an index of nearly 2,000 entries complete the present volume. Previous volumes have been widely reviewed in technical and trade publications such as *American Dyestuffs Reporter, Electrochemical Society Bulletin, Modern Plastics, Rubber Age,* etc., and have received favorable comment. The present volume is a timely addition to the series and will doubtless find wide acceptance among chemists and technologists throughout the industry.

Volume VI has been reviewed in SCIENCE, and previous volumes have been widely reviewed in technical and trade publications and have received favorable comment.

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[2] Rudolf Geiger, Das Klima der bodennahen Luftschicht. Die Wissenschaft. Vol. 78, Braunschweig, Vieweg, 1927.

[3] A single volume of the *Monthly Weather Review* (v. 44, 1916) contains the following articles: C. F. Marvin, "Elementary Notes on Least Squares, the Theory of Statistics and Correlation, for Meteorology and Agriculture. Vol. 44, Oct., 1916, pp. 551–569; William Gardner Reed, "Weather Insurance," Vol. 44, Oct., 1916, pp. 575–580, and "The Probable Growing Season," Vol. 44, Sept., 1916, pp. 509–512; William G. Reed and Howard R. Tolley, "Weather as a Business Risk in Farming," Vol. 44, June, 1916, pp. 354–355; W. J. Spillman, H. R. Tolley and W. G. Reed, "The Average Internal Curve and its Application to Meteorological Phenomena," Vol. 44, Apr., 1916, pp. 197–200; Howard Ross Tolley, "Frequency Curves of Climatic Phenomena," Vol. 44, Nov., 1916, pp. 634–642.

BOOKS RECEIVED

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